Claims

1. A method for manufacturing at least a first photonic device, comprising the steps:

a) epitaxially growing a first set of layers (22), including at least a first waveguide layer (3), on a semiconductor material (1) having a dopant of a first type,

b) applying a first mask (21, 53) on top of the grown layers (22), removing the first set of layers in the unmasked areas, to form at least said first set of layers in a first waveguide mesa (61), and removing the first mask (21),

c) epitaxially growing a cladding layer (7) at least on top of said first waveguide mesa (61), said cladding layer having a dopant of a second type, opposite to said first type,

d) epitaxially growing a contact layer (8) on top of the cladding layer (7), and

e) arranging a first metal contact (9, 80) on top of the contact layer (8), above said first set of layers (22),

characterized in that the method comprises the additional steps:

f) etching the contact layer (8) and the cladding layer (7), using a second mask (9, 70, 71) covering the first waveguide mesa (61), in the unmasked areas, and

g) applying insulating material (25, 82) in the areas not covered with the second mask (9, 70, 71) during etching in step f).

2. The method according to claim 1, wherein the method further comprises the additional steps prior to step c):

b1) epitaxially growing a thin layer (23) having a dopant of the second type on and around the first waveguide mesa, and

b2) epitaxially growing an etch stop layer (24) on top of the thin layer grown in step b1),

whereby the etching in step f) is stopped by the etch stop layer (24) grown in step b2).

3. The method according to any of claims 1-2, wherein said semiconductor material (1) is an epitaxially grown layer on top of a substrate.

4. The method according to claim 3, wherein said substrate is a semi-insulating substrate, or a semiconductor substrate having a dopant of the first or the second type.

5. The method according to any of claims 1-4, wherein said semiconductor material (1) is a semiconductor substrate.

6. The method according to any of claims 1-5, wherein said first photonic device is selected to be any of the group: laser, detector and amplifier.

7. The method according to any of claims 1-6, wherein said first mask (21, 53) is dimensioned to define the width of said first waveguide mesa (61) to achieve single mode operation of said first photonic device.

8. The method according to any of claims 1-7, wherein the following steps are performed prior to step e):

- applying the second mask (70, 71) on the contact layer (8),
- performing step f),
- removing said second mask (70, 71), and
- performing step g).

9. The method according to claim 8, wherein the second mask (70, 71) is a metal mask, preferably made from Titanium.

10. The method according to any of claims 1-7, wherein said first metal contact (9) arranged on top of the contact layer in step e) is used as the second mask in step f).

11. The method according to any of claims 8-9, wherein at least a second photonic device is optically connected with the first photonic device, the method comprising the additional steps prior to step b):

a1) applying an island mask (30) on top of the first set of layers (22) and removing the first set of layers in the unmasked areas,

a2) epitaxially growing a second set of layers (31) for the second photonic device, including at least a second waveguide layer (33), on the semiconductor material (1) in the unmasked areas, and thereafter removing the island mask (30),

thereafter

- modifying step b) so that said first mask (53) also include to cover at least a part of said second set of grown layers (31), thus also forming a second photonic device region (62) coupled to said first photonic device in a light transmission direction, and
- modifying step c) to include growing said cladding layer (7) on top of said second set of layers (31) in addition to said first set of layers (22),
- modifying step e) to include arranging a second metal contact (81) on top of the contact layer (8), above said second set of layers (31), said first (80) and second (81) metal contacts being separated,

- modifying step f) to include using a second mask (70, 71) covering at least a part of said second set of layers (31), in addition to covering the first waveguide mesa, and
- modifying step g) to include applying insulating material (82) in the areas not covered with the second mask (70, 71).

12. The method according to claim 11, wherein the method further comprises the additional steps prior to step c):

b3) epitaxially growing a thin layer (23) having a dopant of the second type on and around the second photonic device region (62), and

b4) epitaxially growing an etch stop layer (24) on top of the thin layer (23) grown in step b3),

whereby the etching in step f) is stopped by the etch stop layer grown in step b4).

13. The method according to any of claims 11-12, wherein said second photonic device is selected to be a modulator.

14. The method according to any of claims 1-13, wherein the method further comprises the step of providing a window section (72) adjacent to the first or the second photonic device in a light transmission direction thereof, where said second mask (70, 71) applied in step f) further include a window masking part.

15. The method according to claim 14, wherein said window masking part is selected to have a tapered shape.

16. The method according to any of claims 1-15, wherein said insulating material (25, 82) is selected to be a material which is easily planarised, preferably polymer.

17. A photonic device including at least a first photonic device comprising:

- a first set of epitaxially grown layers (22), including at least a first waveguide layer (3), arranged in a first waveguide mesa (61) on top of a semiconductor material (1) having a dopant of a first type,
- a cladding layer (7) having a dopant of a second type, opposite to said first type, arranged on top of said first set of layers (22) and the surrounding semiconductor material (1),
- a contact layer (8) arranged on top of the cladding layer (7), and
- a metal contact (9, 80, 81), for each photonic device, arranged on top of the contact layer (8),

characterized in that said cladding (7) and contact (8) layer are shaped in an etching process to have a first contact mesa structure at least above the first waveguide mesa (61), the photonic device further comprises:

- an insulating material (25, 82) applied around the first contact mesa structure, said insulating material having a thickness corresponding to approximately the combined thickness of the cladding (7) and the contact (8) layer.

18. The device according to claim 17, wherein a thin layer (23) having a dopant of the second type is arranged on and around the first waveguide mesa (61), and an etch stop layer (24) is arranged on top of the thin layer (23), whereby the etching of the cladding (7) and contact (8) layer, to shape the first contact mesa structure, is stopped by the etch stop layer (24).

19. The device according to claim 17 or 18, wherein said device further comprises at least a second photonic device,

optically connected to said first photonic device, said second photonic device comprising:

- a second set of epitaxially grown layers (31), including at least a second waveguide layer (33), formed in a second photonic device region (62) being, coupled to said first photonic device in a light transmission direction, on top of the semiconductor material (1), and
- said cladding (7) and contact (8) layer are arranged on top of each second photonic device region (62).

20. The device according to claim 19, wherein said cladding (7) and contact (8) layer also are shaped to have a second contact mesa structure above a part of said second photonic device region (62), said first and second contact mesa structure being adjacent to each other.

21. The device according to claim 20, wherein a thin layer (23) having a dopant of the second type is arranged on said second photonic device region (62), and an etch stop (24) layer is arranged on top of the thin layer (23), whereby the etching of the cladding (7) and contact (8) layer, to shape the second contact mesa structure, are stopped by the etch stop layer (24).

22. The device according to any of claims 17-21, wherein said first photonic device is any of the group: laser, detector and amplifier.

23. The device according to any of claims 19-22, wherein said second photonic device is a modulator.

24. The device according to any of claims 19-22, wherein said device is provided with a window section (72) arranged adjacent to said first or second photonic device in a light

transmission direction thereof, said window section is preferably tapered.

25. The device according to any of claims 17-24, wherein said semiconductor material (1) is an epitaxially grown layer on top of a substrate.

26. The device according to claim 25, wherein said substrate is a semi-insulating substrate, or a semiconductor substrate having a dopant of the first or the second type.

27. The device according to any of claims 17-24, wherein said semiconductor material (1) is a semiconductor substrate.

28. The device according to any of claims 17-27, wherein said insulating material (25, 82) is a material which is easily planarised, preferably polymer.